Nov. 21, 1944. O. C. SCHAUBLE 2,363,267

DIFFUSION BAFFLE FOR OIL HEATERS

Filed Feb. 15, 1943

Fig. 1.

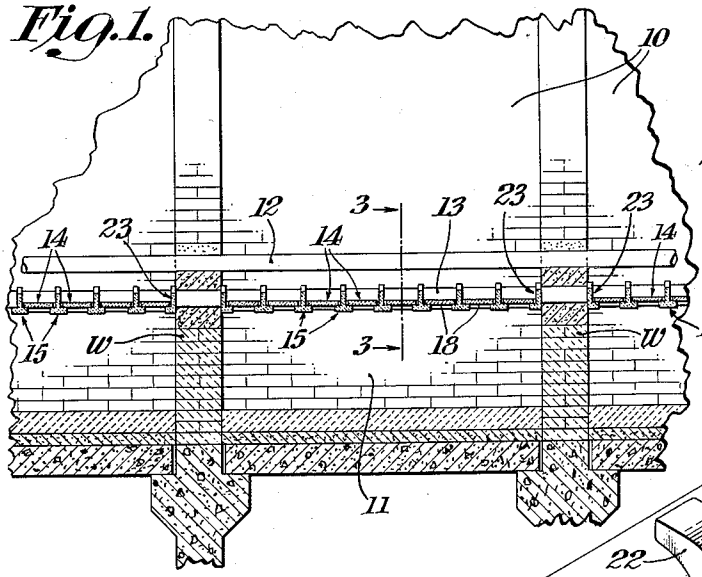



Fig. 5.

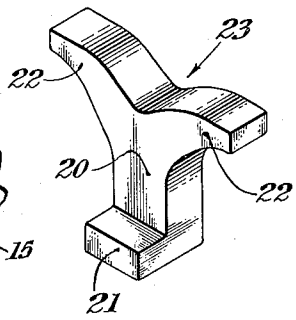



Fig. 2.

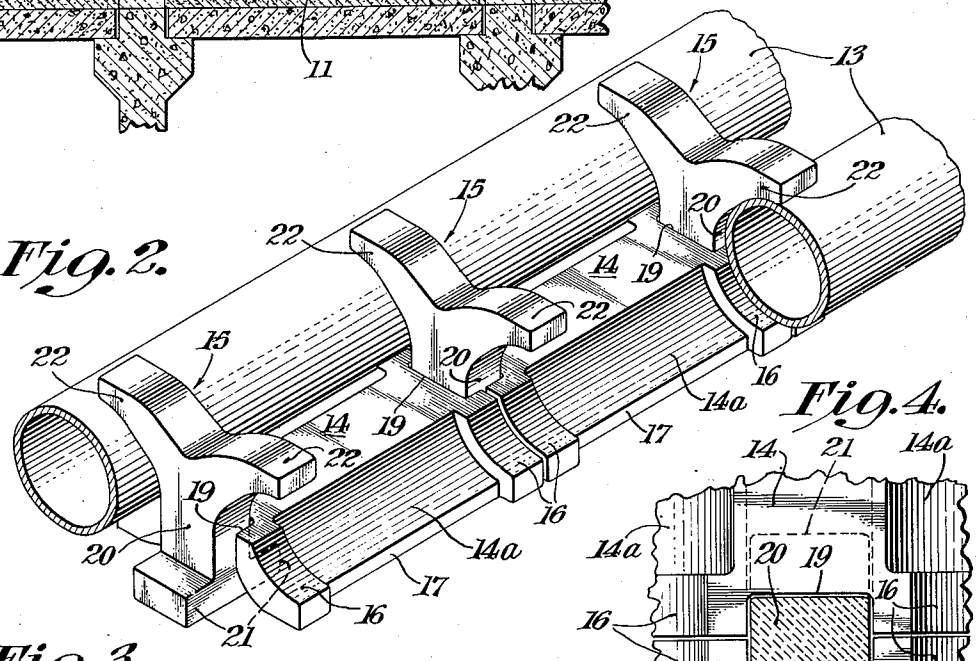
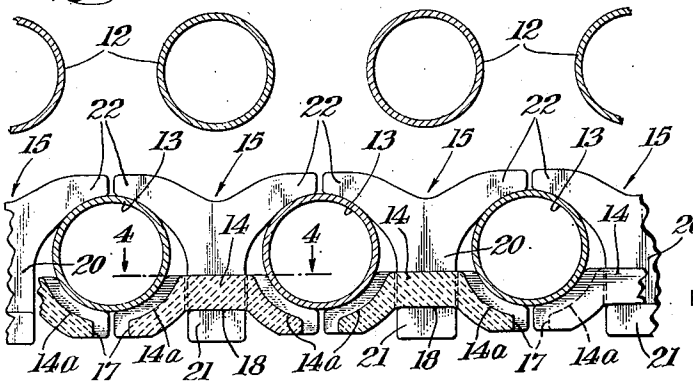



Fig. 4.




Fig. 3.




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## DIFFUSION BAFFLE FOR OIL HEATERS

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Application February 15, 1943, Serial No. 475,958

4 Claims. (Cl. 110—98)

This invention relates to oil heaters and especially to an improved diffusion baffle structure for employment in a furnace in which hydrocarbon oils are subjected to heating for purposes of distillation, cracking, or the like. More particularly, the invention relates to a baffle structure devised for use in connection with an inverted type furnace such as that disclosed in my copending patent application, Serial No. 445,128, filed May 30, 1942.

In the furnace described in my copending application, horizontal oil-conducting tubing forms the bottom of a combustion or radiant-heating chamber, and the combustion gases flow downwardly over this tubing and through the spaces therebetween to an underlying plenum chamber. My present invention is directed more particularly to the provision of a satisfactory baffle structure for obtaining increased heat transference from the flowing gases to this tubing.

The principal object of my invention is to provide an improved diffusion baffle for a furnace of the type described.

A further object of my invention is to provide a diffusion baffle for a furnace of the type described in my copending application, the individual elements of which can be formed, assembled, and associated with the furnace tubing so as to obtain a well-distributed flow of the combustion gases over such tubing.

Another object of my invention is to provide a support for the baffle-forming elements for convenient suspension thereof from the horizontal tubing of my inverted type furnace and also for convenient installation of such elements entirely from the under side of the tubing.

A still further object of my invention is to provide improved baffle-forming elements for my suspended diffusion baffle construction and to provide improved hanger elements designed for ready application to the tubing from the under side thereof and also designed for ready support of the baffle-forming elements in operative relation to the tubing.

Still another object of my invention is to provide hanger elements for the aforesaid purpose designed to render their fabrication from ceramic material entirely practicable from a manufacturing standpoint and from a service standpoint whereby economy and conservation of metal are effected.

Further objects and advantages of my invention will appear from the following description of a preferred form of embodiment thereof taken in connection with the accompanying drawing, in which:

Fig. 1 is a vertical longitudinal sectional view of a portion of an oil heater or furnace equipped with my improved diffusion baffle;

Fig. 2 is a perspective view of a portion of the baffle structure and the individual elements thereof as applied to the horizontal tubing;

Fig. 3 is an enlarged vertical transverse section on the line 3—3 of Fig. 1;

Fig. 4 is an enlarged detail horizontal section on the line 4—4 of Fig. 3; and

Fig. 5 is a perspective view showing the type of hanger employed at the ends of the rows of baffle-forming elements.

The heater indicated in Fig. 1 is provided with a combustion chamber or radiant-heating chamber 10 and an underlying plenum chamber 11. As described in my copending application, between these chambers there are a horizontal row of spaced upper tubes 12 and a horizontal row of spaced lower tubes 13 parallel to the upper tubes and in staggered relation thereto. Low transverse walls W extend upwardly from the bottom of chamber 11 for support of the tubes 12 and 13 at intermediate points along their length and are provided with suitable openings through which such tubes extend. There are also tubes along the side walls of the chamber 10; but these tubes, along with other details of the heater, are omitted from the drawing in order to simplify the illustration. Oil to be heated for the desired purpose is conducted through such tubing in a suitable manner.

This heater is desirably heated by suitable gas burners or the like placed in the end walls thereof. In this manner, radiant heat is supplied to the horizontal rows of tubes 12 and 13 as well as to the side wall tubes (not shown) with the lower row of tubes 13 receiving considerably less radiant heat than the upper row of tubes 12. The resulting combustion gases, in this type of heater, pass downwardly over the rows of tubes 12 and 13 and through the plenum chamber to the stack (not shown). The utilization of the entire floor area of the heater as a gas exit from the combustion chamber thus provides a low-velocity gas flow past the horizontal rows of tubes, which flow is particularly desirable so as to avoid excessive heat transfer by convection to the tubes 12.

To avoid channeling of the gases as they flow past the tubes 12 and the resulting local overheating thereof, a diffusion baffle is desirably installed in this zone and is preferably positioned in operative relation to the lower tubes 13. Pas-

sages are provided in this baffle for the flow of the combustion gases therethrough. These passages are uniformly distributed throughout the baffle and have an aggregate flow area less than the intertube area of the upper row of tubes. In this manner, the gases during their passage through this baffle are subjected to a pressure drop which causes these gases to flow substantially uniformly across the entire upper row of tubes. Uniform heating of tubes 12 is thereby accomplished. Furthermore, a high rate of heat transfer to tubes 13 is provided, and a greater heat absorption by these tubes is obtained.

According to my invention, I have provided an improved diffusion baffle structure particularly for use with my inverted type oil heater. This baffle is supported by the lower tubes 13 and comprises an assembled structure designed to conduct the hot combustion gases in narrow streams from the chamber 10 around the lower quadrants of the tubes 13 into the underlying plenum chamber 11. Preferably, all elements or parts of the baffle are formed of ceramic, tile, or other refractory material. These parts include baffle-forming elements, blocks, or plates 14 and hanger elements 15 for supporting the blocks by suspension from the tubes 13. A single row of blocks is provided in the space between each pair of tubes. The hanger elements engage the under side of the blocks, extend upwardly through such space, and engage the upper sides of the tubes 13 to support the blocks in an assembled structure.

Each block 14 is approximately rectangular in plan, and its width between the longer edges is desirably slightly less than the distance between the center lines of adjacent tubes 13. The intermediate portion of these edges is recessed to provide the concave arcuate surfaces 14*a*, having a radius exceeding that of the outer circumference of the tubes 13. The recessed surface is desirably substantially concentric with the external surface of the tubing. By means of this recessing, narrow concave ridges 16 are left at the end margins of each block. These ridges are arcuate and have a radius substantially corresponding to that of the tubing so that they closely fit the lower quadrants of adjacent tubes and serve to position each block with respect thereto. When each block is in position, the tubes engaged thereby and the arcuate surfaces 14*a* together define long narrow passages for conducting the hot combustion gases downwardly around the lower quadrants of the tubes. In order to permit free and ready flow of these gases from such passages into the underlying plenum chamber 11, the lower edges 17 of the recessed portion of each block are also set back from the line of the ridges 16 so that adjacent blocks form a long narrow exit slot. The under side of each block is shaped from end to end like an inverted trough, and a narrow flat bottom surface 18 is provided. The central portion of the shorter ends of each block are recessed to form the notches 19.

Each hanger 15 preferably comprises a vertical stem portion 20 of rectangular cross section, flat horizontal foot portions 21 extending in opposite directions from the broad sides of the stem, and substantially arcuate arm portions 22 diverging from the upper end of the stem in a vertical plane at right angles to that of the foot portions. In effect, these arm portions form an elongated head whose length exceeds the width of the space between the tubes 13. Preferably, the length of this head is only slightly less than the distance between the center lines of adjacent tubes. The major dimension of the stem cross section is less than the width of the space between each pair of tubes. The width of the head corresponds to the minor dimension of the stem cross section so that the head width is materially less than the width of the intertube space.

Each of the end notches 19 of a block has a size sufficient to receive approximately one-half the width of the stem of a hanger with a slight working clearance so that adjacent blocks can be brought quite close together. Since the stems of the hangers are rectangular in cross-sectional area and the notches are also cut in a rectangular outline, the hangers are held against rotation about their stems; and thereby their heads are held against release from the tubes. This keying effect is assisted by the trough shape of the under side of the several blocks, which shape holds the foot projections 21 against lateral shifting. The blocks and hangers are so proportioned as to enable the hangers to support the blocks with the end ridges 16 of the blocks relatively close to the lower quadrants of the tubes. Furthermore, the dimensions of the respective pieces are so proportioned that sufficient clearance for ready manipulation thereof can be provided.

Rows of the blocks and hangers extend along all of the intertube spaces between the walls W and between such walls and the end walls of the furnace. For support of the end blocks of each row, hangers 23 of special design are provided. One of these hangers is shown in Fig. 5. It is precisely like the hangers 15 except that it is formed with only one of the block-supporting feet 21. At its opposite side, this hanger is flat throughout.

The blocks and the hangers are designed not only to provide a diffusion baffle having the desired characteristics, but also for convenient assembly and attachment to the tubing 13. Preferably, both the blocks and the hangers are inserted into place from the under side of the tubing 13. This procedure is followed inasmuch as it is customary to install the two horizontal rows of tubing and the other tubes before placing the required refractory material in position. In this manner, the obstructing effect of the staggered upper row of tubing is avoided. The insertion and installation of the diffusion baffle from the upper side of tubing 13 is possible, however, but is not desirable in view of the greater difficulties inherent in such procedure in view of the construction of the inverted type furnace.

In installing each row of the baffle blocks, one of the special hangers 23 is first operatively applied to the respective pair of tubes 13. The insertion of the hanger is accomplished from the under side of the tubing by disposing the elongated head of the hanger lengthwise of the tubes, inserting the hanger upwardly through the intertube space, and then rotating the hanger about the axis of the stem to dispose the head crosswise of the tube and to permit it to rest upon both tubes. The hanger is then slid along the tubing until it bears flat against the adjacent furnace wall. One of the blocks is next fitted upwardly against the adjacent lower quadrants of the pair of tubes and is then slid back along the tubes until its flat bottom surface 18 overlaps the foot projection 21 of the hanger and the stem of the hanger enters the notch 19 at that end of the block. This first block, so placed, is held in position, and one of the hangers 15

is applied to the pair of tubes from the under side thereof in the same manner as the hanger 23 and is slid back along the tubes until its stem enters the adjacent end notch 19 of such block and one of its foot projections 21 is disposed beneath the under surface 18 of the block.

Another block is next placed against the tubes and slid back until one of its end notches receives the stem of the second hanger and its bottom surface overlaps the opposite foot projection 21 of the second hanger. Subsequent blocks and hangers are assembled in the same manner until there is space for only one more block at the end of the row. Another one of the end hangers 23 is then applied to the tubes and disposed flat against the adjacent wall, and the final block is then engaged with the foot projection 21 of such hanger. For insertion of this final block, the previously placed blocks and hangers along the row are moved together; and, after insertion of this block, they are spread slightly apart so as to lengthen the row until the hanger 15 adjacent the final block is advanced far enough to have its stem engage the adjacent notch 19 of such block and the adjacent foot projection 21 of such hanger is engaged with the under side of this final block.

Of course, in the operation of assembling this diffusion baffle, the order of placing the blocks and hangers in position may be varied somewhat. For example, if desired, all of the required hangers may be applied to the tubes prior to applying the blocks thereto.

When it is necessary to dismantle the baffle or to remove a defective block or hanger, disassembling of the baffle is readily effected by merely forcing the blocks and hangers in the particular row closer together to thereby release one of the end blocks and hangers. Such end block and hanger may then be manipulated for removal from the tubes. Space is thereby provided for manipulation of the remaining blocks and hangers in the row for release of the desired element. Any one of the hangers is detachable by rotating it until its elongated head is disposed lengthwise of the intertube space and then lowering the hanger through such space.

The following example illustrates the application of my improved diffusion baffle assembly to the oil heater described in my copending application, Serial No. 445,128. In this case, the tubes 12 and 13 were $5\frac{2}{16}$ inches in outside diameter, and the distance between the center lines of adjacent tubes was 10 inches. Each block was $12\frac{3}{4}$ inches long and $9\frac{7}{8}$ inches wide; and the amount of recess of surface 14a and edge 17 was $\frac{5}{8}$ inch. Notch 19 was $3\frac{1}{4}$ inches wide by 1 inch deep. Each hanger was $8\frac{1}{8}$ inches high, and the spread of its arm portions was $9\frac{3}{4}$ inches. The stem had dimensions of 3 inches by 2 inches in cross section, and the foot portions 21 were $1\frac{1}{2}$ inches long. For the complete assembly of the baffle, approximately 470 blocks 14, 420 hangers 15, and 315 hangers 23 were required.

It will be seen that this baffle is designed to obtain a distribution of the flow of hot combustion gases for maximum transfer of heat to the tubing and that the parts of the baffle are designed to greatly facilitate assembly and use. It will also be seen that the parts are simply and durably constructed and are designed to render their construction out of suitable refractory material entirely practicable.

Although I have described my invention in connection with an oil heater, its application is not necessarily so limited; and it may be used in other types of furnaces. While I have disclosed a very satisfactory form and embodiment of my invention, it will be understood that the structure of the baffle may be modified and that it may be employed in services other than that disclosed without departing from the invention as defined in the appended claims.

I claim:

1. A bottom wall structure for a combustion chamber, comprising parallel fluid-conducting tubes horizontally spaced in a common plane; rows of refractory blocks applied to the under side of said tubes and arranged in the respective rows in endwise opposed relation in succession along the spaces between the tubes, each of said blocks extending laterally across its respective intertube space and having projections engaging lower quadrant portions only of the adjacent tubes, said projections being spaced along the tubes to permit downward passage of combustion gases in contact with the lower quadrant portions of the tubes for heating the fluid within the tubes and each of said blocks having a medially located notch in each end thereof; and supporting elements for said blocks and each comprising a rigid piece of ceramic material formed with a shank portion extending upwardly through said notches of opposed block ends, a head portion at the upper end of said shank elongated in form transversely of the shank and extending laterally from opposite sides of the shank and engaging the upper sides of adjacent tubes and foot portions at the lower end of said shank portion and engaging the under side of said opposed block ends to support the blocks, the width of said head portion and shank portion lengthwise of the tubing being less than the width of the intertube space and the length of the head transversely of the tubing exceeding the width of the intertube space to enable application of the element to the tubes by disposal of the element with its head portion lengthwise of the tubes, insertion of the element upwardly through the intertube space and rotation of the element to dispose the head crosswise of the tubes.

2. A wall structure for a heating chamber, comprising parallel fluid-conducting tubes transversely spaced in a common plane; rows of refractory blocks applied to the under side of said tubes and arranged in the respective rows in endwise opposed relation in succession along the spaces between the tubes, each of said blocks extending laterally across its respective intertube space and engaging quadrant portions of the adjacent tubes located at one side only of said plane and each block having a medially located notch in each end thereof; and supporting elements for said blocks and each comprising a rigid piece of non-metallic refractory material formed with a shank portion extending through said notches of opposed block-ends, a head portion at one end of said shank elongated in form transversely of the shank and extending laterally from opposite sides of the shank to engage the sides of adjacent tubes at the opposite side of said plane and foot portions at the opposite end of said shank portion and engaging the opposed end portions of the blocks to support the blocks, the width of said head portion and shank portion lengthwise of the tubing being less than the width of the intertube space and the length of the head transversely of the tubing exceeding the width of the intertube space to enable application of the element to the tubes by disposal

of the element with its head portion lengthwise of the tubes, insertion of the element through the intertube space from said opposite side of said plane and rotation of the element to dispose the head crosswise of the tubes.

3. A wall structure for a heating chamber, comprising parallel fluid-conducting tubes transversely spaced in a common plane; rows of refractory blocks applied to the under side of said tubes and arranged in the respective rows in endwise opposed relation in succession along the spaces between the tubes, each of said blocks extending laterally across its respective intertube space and engaging quadrant portions of the adjacent tubes located at one side only of said plane and each block having a medially located notch in each end thereof; and supporting elements for said blocks and each formed with a shank portion extending through said notches of opposed block ends, a head portion at one end of said shank elongated in form transversely of the shank and extending laterally from opposite sides of the shank engaging the sides of adjacent tubes at the opposite side of said plane and foot portions at the opposite end of said shank portion and engaging the opposed end portions of the blocks to support the blocks, the width of said head portion and shank portion lengthwise of the tubing being less than the width of the intertube space and the length of the head transversely of the tubing exceeding the width of the intertube space to enable application of the element to the tubes by disposal of the element with its head portion lengthwise of the tubes, insertion of the element through the intertube space from said opposite side of said plane and rotation of the element to dispose the head crosswise of the tubes.

4. A wall structure for a heating chamber, as claimed in claim 3 and including supporting elements each having a shank portion and a head portion according to those of the supporting elements claimed in claim 3 and in a similar relation to the tubes and each having a single foot portion, said elements being located respectively at the ends of the rows of blocks, and said foot portion engaging the adjacent end block to support the latter.

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